7.

A Deſcription of the Teeth of the Anarrhichas Lupus Linnæi, *and of thoſe of the* Chætodon nigricans *of the ſame Author; to which is added, an Attempt to prove that the Teeth of cartilaginous Fiſhes are perpetually renewed. By Mr.* William Andre, *Surgeon; communicated by Sir* Joſeph Banks, *Bart. P. R. S.*

Read at the Royal Society, March 18, 1784.

THE amazing variety there is in the external form of fiſhes muſt be obvious to a common obſerver; and whoever examines will be convinced, that the ſame variety prevails in their internal ſtructure. No parts, perhaps, afford a more convincing proof of the laſt aſſertion than the teeth of fiſhes. To adduce a few inſtances, let us only recollect the tuberculated teeth in the thorn-back; the triangular ſerrated teeth in the ſhark; the ſlender flexible teeth in the *chætodontes*, or angel-fiſhes. There is not only a difference of their form, but alſo in the ſubſtances of which they are compoſed; ſome being of a ſoft horny nature; others made up of bone; others of that ſubſtance we call enamel in the teeth of quadrupeds; and ſome having the apparent hardneſs and tranſparency of cryſtal. We may alſo notice their uncommon ſituation; many fiſhes having teeth not only in their jaws, but on the tongue, the palate, and about the *fauces*.

To illuſtrate in ſome degree this part of natural hiſtory, I ſhall deſcribe the teeth of the *Anarrhichas Lupus*, or Sea-wolf, and thoſe of the *Chætodon nigricans*, a ſpecies of

Angel-fiſh. The former have been but imperfectly deſcribed, and never repreſented diſtinct from the fiſh, without which it is impoſſible to have any exact idea of their diſpoſition, number, or form, while the true ſhape and compoſition of the latter, from their minuteneſs, have been entirely overlooked. I ſhall then attempt to prove, that a continual renovation of the teeth takes place in cartilaginous fiſhes.

THE SEA-WOLF is a fierce and ravenous fiſh, as its name imports, found in the northern parts of the globe, where it frequently grows to the length of four feet and upwards.

The jaws of the Wolf-fiſh are made up of ſeveral bones, to each of which a greater or leſs number of teeth are affixed; but, before I enter upon the deſcription of them, I ſhall take notice of the palate (marked A. tab. XI.), that being a kind of baſis or ſupport to the other bones, to which they are all more or leſs connected. The palate is a thick and firm bone united above to the bones of the *cranium* and noſe, and ending below in a flat oval ſurface, on which are incruſted about twelve or thirteen ſtrong, blunt, and rather flat teeth of the *molar* or grinder kind. The external edges of the teeth are the moſt prominent; by which means a hollow is formed in the middle of the palate.

The upper jaw is compoſed of three bones, two of which (BB) are placed laterally, forming the ſides of the upper jaw, and the third (C) anteriorly, making the fore-part of the jaw. The third bone may be divided through its middle into two portions; but ſince it has the appearance of one bone only, the connection being very firm, I ſhall deſcribe it agreeably to that appearance, to prevent needleſs diviſions.

The ſide bones of the upper jaw have nearly the ſhape of an italic *ſ*. At their poſterior ends may be obſerved a ſmooth arti-

articular ſurface, for their connection with a ſimilar ſurface on the poſterior extremities of the lower jaw; and on their anterior ends there are two rows of teeth. The external row conſiſts of three or four ſharp or conical teeth; and the internal row of four or five blunt and rather flat ones. Theſe bones are connected to the palate and bones of the noſe by looſe but ſtrong ligaments.

The third bone of the upper jaw, which may be called the anterior or naſal portion, is of a triangular form, connected above to the bones of the noſe, and ending below in a flat ſurface, thick-ſet with ſharp conical teeth. The external teeth, about four in number, are large and ſtrong, and bend a little inwards; but the internal ones are ſmall, and nearly ſtraight, of which we may reckon about ten.

This bone is connected above (as I have before obſerved) to the bones of the noſe; between which a complete joint is formed, of that kind called by anatomiſts *ginglymus*, that is, where the projecting parts of one bone are received by correſponding cavities in the other. Like other articulations, it is furniſhed with a capſular ligament, and no doubt an apparatus for the ſecretion of *ſynovia*. Although a joint exiſts between this bone, and thoſe of the noſe, yet no muſcles are provided for its motion, which depends entirely upon the reſiſtance made by thoſe hard bodies which the animal takes into its mouth.

The lower jaw (D) conſiſts of two bones, united at their fore-parts by a ſtrong ligament, which allows of ſome motion. On their anterior extremities are placed ſix large and as many ſmall ſharp and conical teeth; the large teeth are placed externally, and their points are bent a little inwards; while the ſmall ones, which ſtand within them, are nearly ſtraight. Behind theſe are two or three rows of grinder teeth. The external teeth ſtand nearly upright; but the internal ones are placed obliquely, inclining towards each other.

The teeth are formed of a hard bony matter, not covered with enamel as in ſome animals; nor is there an equal diſtribution of enamel and bone as in ſome others. They are not fixed in ſockets, but are faſtened to the jaws in the ſame manner as the *epiphyſes* are united to the bodies of the bones in young animals.

From the foregoing deſcription it will appear, that the anterior ſharp teeth of the Sea-wolf are admirably calculated for ſeizing its prey, while the poſterior grinding teeth ſerve to break down the hard ſhells of lobſters, crabs, muſcles, ſcollops, &c. which this animal is known to feed upon. The external teeth on the ſides of the upper and lower jaw being higher than thoſe placed within them, a hollow is formed above and below, in which the convex ſhells of cruſtaceous animals, &c. are confined during their compreſſion between the jaws, which is effected by the action of ſtrong muſcles placed on the ſides of the head. The jaws being made up of a number of pieces, and connected by looſe ligaments, a freedom of motion is allowed, and the colliſion or ſhock ariſing from the comminution of hard bodies is ſo much the leſs by being divided among a number of bones.

MERRET informs us *, the *lapis buſonites* are the flat grinder teeth of this fiſh petrified. But certainly theſe foſſils are not the production of the Sea-wolf alone, ſince they may originate from all thoſe fiſhes which have flat teeth in their palate or jaws; a ſtructure which the French naturaliſts diſtinguiſh by the appellation of *palais pavé*.

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* Pinax Rerum Naturalium Britannicarum.

OF THE CHÆTODON NIGRICANS.

The individual which furniſhed the following account was brought from the Weſt Indies, and meaſured about five inches in length *. Its teeth (the only parts I mean to deſcribe) were ſo ſmall as to require the aſſiſtance of a microſcope to diſcover their real ſhape. There were fourteen teeth in each jaw, ſeven of which from the upper one are repreſented tab. XII. They conſiſt of a cylindrical body fixed in the jaw, above which they ſpread out into a broad and rather flat ſurface, on the edges of which are twelve or thirteen *denticuli*, making an uncommon appearance, and totally different from the teeth of any other animal. Another ſingularity is their being tranſparent, unleſs viewed with a deep magnifier, when a few opaque lines may be perceived, which point out the cellular part of the tooth through which the blood veſſels ramify, which are deſtined for its growth and nouriſhment. They are not all of the ſame length. Thoſe in the anterior parts of the jaws are the longeſt, from whence they gradually diminiſh in length as they approach the angles of the mouth.

From the foregoing deſcription of the teeth of the *Chætodon nigricans*, this fiſh ſeems to be miſplaced in the *Syſtema Naturæ* of LINNÆUS; ſince one generic diſtinction of the *Chætodontes* is to have numerous, ſlender, and flexible teeth; whereas the teeth of the *Chætodon nigricans* are few in number, placed in one row, and of a cryſtalline hardneſs.

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* This fiſh is well repreſented in DU HAMEL Traité général des Pêſches, tom. III. ſeconde partie, ſection IV. planche xii. under the name of *Chirurgien ou Porte Lancette.*

OF THE TEETH OF CARTILAGINOUS FISHES.

When STENO examined the teeth of the ſhark, he was ſurpriſed to find a great number of them placed on the inſide of each jaw, lying cloſe to the bone, and many of them buried in a looſe ſpongy fleſh; concluding that theſe internal teeth could be of little or no uſe to the animal. Mr. HERISSANT * afterwards ſhewed the uſe of theſe internal or poſterior teeth, by proving, that as the anterior teeth of each row are broken off, drop out, or wear away, the poſterior ones come forward to ſupply their places †.

But though it be certain that the anterior teeth, when loſt, are replaced by the poſterior ones, neither of the above naturaliſts, or any other that I know of, have attempted to aſcertain how often this circumſtance happens. Whether the renovation be perpetual during life; or whether that operation be ſuſpended after a limited number of teeth have been ſupplied.

From a ſingular circumſtance, which I met with ſome time ago, I am inclined to think the former is the fact; or, that in cartilaginous fiſhes, ſuch as ſharks, rays, &c. there is a perpetual renovation of the teeth.

Being engaged in diſſecting the jaws of a very large ſhark, I was ſurpriſed to find a portion of that ſharp, bearded bone found in the tail of the fire-flaire, or ſting-ray ‡, driven quite

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* BOMARE Dictionaire d'Hiſtoire Naturelle, article Requien.

† It may not be improper on this occaſion to point out a miſtake which ſome naturaliſts have fallen into, in allowing a ſet of muſcles for raiſing the numerous teeth placed in the jaws of ſharks. I have frequently diſſected the jaws of thoſe animals, and am certain no ſuch muſcles exiſt, nor are they indeed at all neceſſary.

‡ *Raia Paſtinaca* LINNÆI. The French naturaliſts, on account of the bone in the tail, call this fiſh *Raie baionnette*.

through

through the lower jaw among the poſterior teeth, and fixed almoſt immoveably. How this happened muſt be obvious to every one. (See the figure, tab. XIII.)

Before I proceed, it will be neceſſary to obſerve, firſt, that the poſterior teeth of cartilaginous fiſhes are always found in a ſoft, membranous ſtate, and but imperfectly formed; notwithſtanding this, they have the whiteneſs of teeth from a ſmall quantity of calcareous earth already depoſited within their ſubſtance. Their hardneſs and perfect form is acquired as they advance towards the anterior parts of the jaws. Secondly, that of the three angles in each tooth of the ſhark, one is placed towards the right, another towards the left, and the other, which is in the middle, and the moſt acute angle, is directed inwardly towards the tongue or *fauces.* They are placed then in ſuch a manner as that the angles of the teeth on the left-ſide in one row, approach the angles of the teeth on the right-ſide in the next row. Thoſe teeth which ſtand on a line from without inwards, I call a row; not thoſe which are placed nearly in a parallel line from one ſide of the mouth to the other.

The ſharp bone of the ſting-ray was fixed in the lower jaw between two rows of teeth, and at their poſterior part, where the firſt rudiments of the future teeth are formed, and it will be clear to every one, particularly thoſe who are converſant in ſuch matters, that this could not have happened without producing a great deal of pain, ſwelling, and diſorder in the part where it was fixed. It is unneceſſary to enumerate the different kinds of miſchief this might occaſion. Let it ſuffice to obſerve, that on account of the ſpace taken up by this extraneous body, the teeth on each ſide of it, for want of room, could never after be perfectly formed. The teeth on the left-ſide

wanting

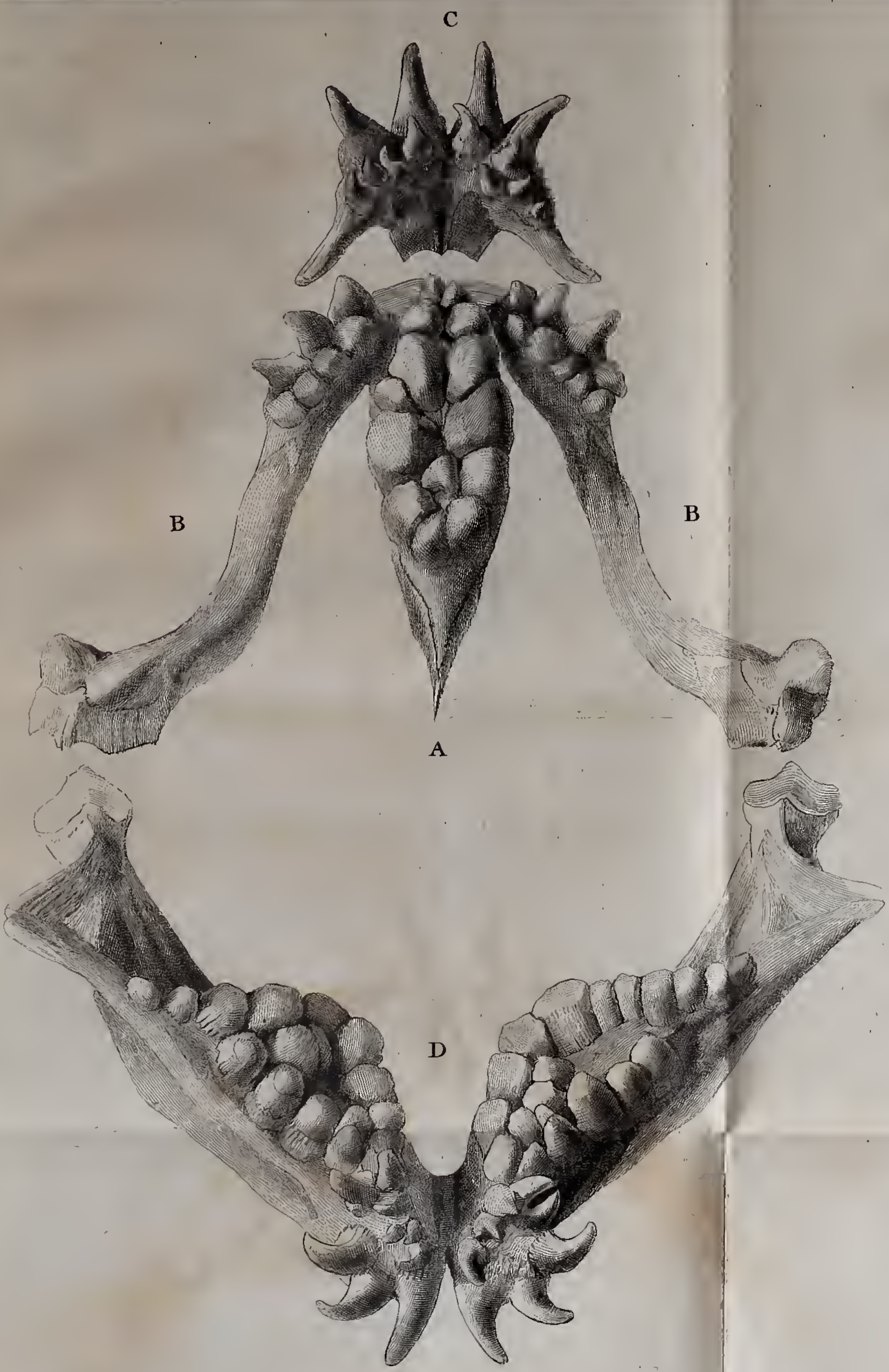
wanting their angles to the right, and the teeth on the right-ſide being deſtitute of their angles to the left.

As it is certain, that the anterior teeth were formerly poſterior ones, and as the teeth in each row were all deficient in one angle, it follows, that they muſt have been formed poſterior to the inſertion of this extraneous body. Again, if we allow that before the accident the animal was in poſſeſſion of perfect teeth, it follows alſo, that they were conſumed and replaced by imperfect ones.

There were ſix teeth in each row, and fifty-two rows, making together about 312 teeth. Now allowing the conſumption to have been equal in all parts of the jaws, it follows, that the animal had already conſumed 312 teeth, and was in poſſeſſion of a like number for future conſumption.

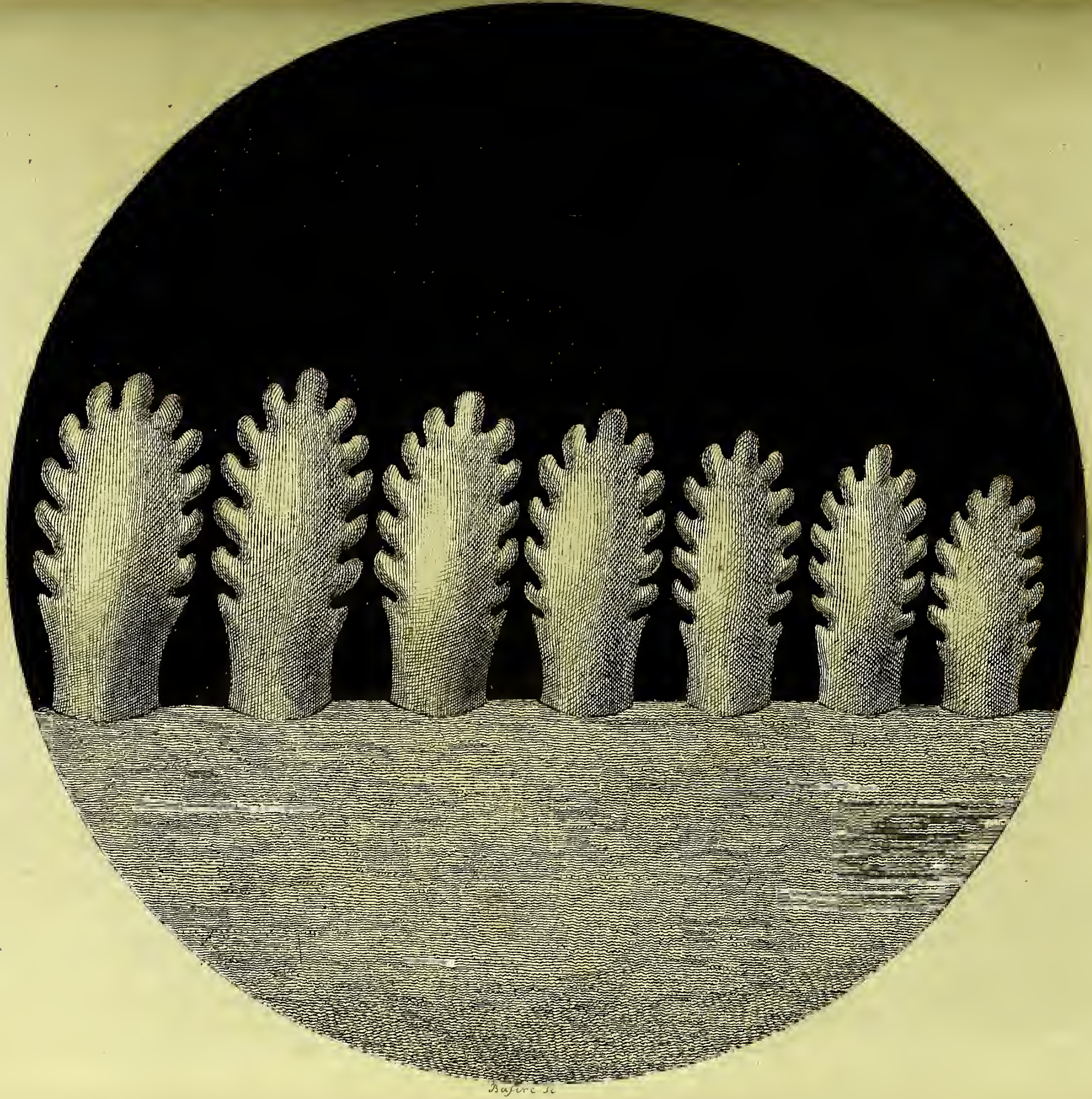
The teeth of ſharks, rays, &c. may be divided into active and paſſive. The active teeth are the anterior ones of each row, ſtanding with their points upwards. The paſſive teeth are the remaining ones, lying one upon another, like the tiles upon a houſe (imbricated), with their points downwards. It appears from the foregoing account, that the anterior or active teeth had been replaced ſix times; and that they might have been renewed ſix times more, making in all twelve times. From which, I think, we may reaſonably conclude, that this does not happen any preciſe number of times; but that the renovation is perpetual during the life of the animal.

The longevity of fiſhes is a fact pretty well eſtabliſhed. In addition to this part of natural knowledge, I have endeavoured to prove, that a part of the inhabitants of the great deep retain, in the article of teeth, a perpetual juvenility, being apparently utter ſtrangers to edentulous old age.

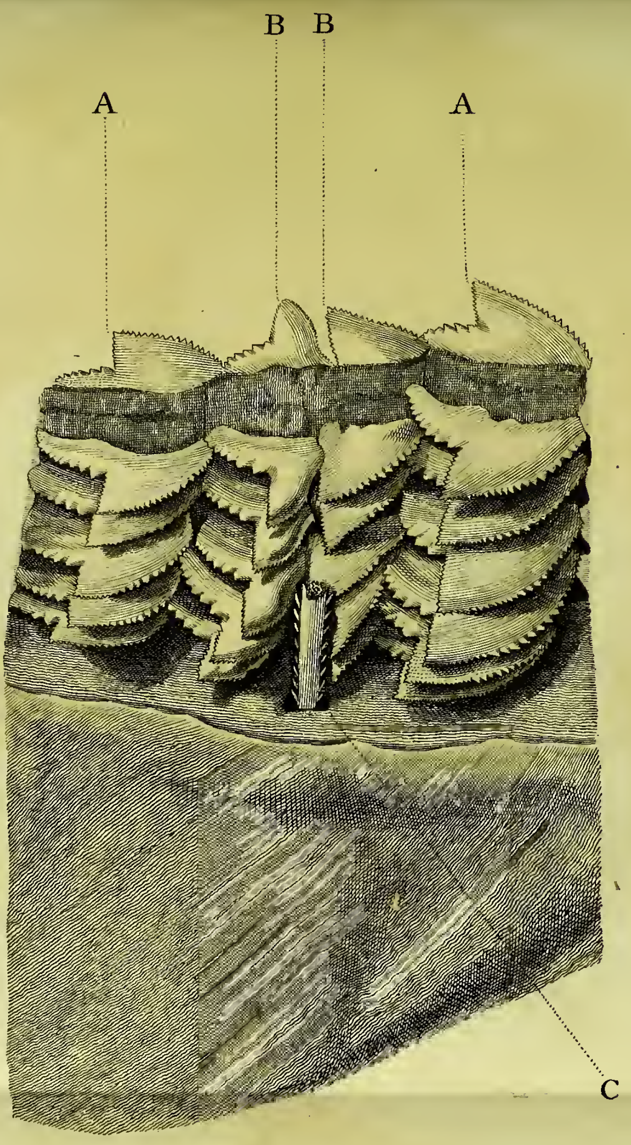


ANARHICHAS Lupus *LINN.*

Baſire ſc.



CHÆTODON nigricans *LINN.*



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EXPLANATION OF THE PLATES.

Tab. XI. The jaws of the Wolf-fiſh.
    A. The palate.
    BB. The ſide bones of the upper jaw.
    C. The anterior or naſal portion of the ſame.
    D. The lower jaw.
Tab. XII. The teeth of the *Chætodon nigricans* magnified.
Tab. XIII. Part of the lower jaw of a large ſhark.
    AA. Two rows of perfect teeth.
    BB. Two rows of imperfect ones.
    C. The bone of the ſting-ray.